Professor Lukasz Fidkowski

Office: Physics B 411 (won't be using it because we are remote this quarter)

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Grading:

homework: 50%

midterm 1: 20%

midterm 2: 10%

final: 20%

Syllabus:

Week 1, Sept 30 - Oct 2 (short week, starts on a Wednesday):

classical statistical mechanics: Liouville theorem, microcanonical ensemble (Kittel Ch. 1-5, Arovas Ch. 1.4.2)

Week 2, Oct 5 - Oct 9:

entropy, central limit theorem, conditions for equilibrium; energy, enthalpy, Helmholtz and Gibbs free energies, entropy of ideal gas, Gibbs paradox (Kittel Ch. 6 - 9).

Week 3, Oct 12 - Oct 16:

classical thermodynamics: Carnot cycles, derivation of entropy from thermodynamic considerations and the three laws of thermodynamics (Tong Ch. 4 on Classical Thermodynamics).

Week 4, Oct 19 - Oct 23:

The canonical ensemble, ideal gases, thermodynamic functions for the canonical ensemble, Maxwell distribution and equipartition, grand canonical ensemble (Kittel Ch. 11-14).

Week 5, Oct 26 - Oct 30:

Quantum mechanics: density matrix, canonical ensemble.

Week 6, Nov 2 - Nov 6:

Quantum gases: Fermi gas, Fermi-Dirac distribution, Sommerfeld expansion (Kittel Ch. 19-21 and Tong Ch. 3).

Week 7, Nov 9 - Nov 13:

Quantum gases: Bose-Einstein distribution, blackbody radiation, Planck distribution (Tong Ch. 3)

Week 8, Nov 16 - Nov 20:

Continuation of quantum gases: Phonons, Bose-Einstein condensation (Tong Ch. 3)

Week 9, Nov 23 - Nov 25 (Thanksgiving week):

Continue quantum gases: finish Bose Einstein condensation, start Pauli paramagnetism and Landau diamagnetism (Tong Ch. 3)

Week 10, Nov 30 - Dec 4:

finish magnetism, start non-ideal gases: diatomic gases, classical virial expansion, Van der Walls equation of state (Tong Ch. 3 and 2)

Week 11: Dec 7 - Dec 11:

Phase transitions, Clausius-Clapeyron equation, critical fluctuations (Tong Ch. 5)

Logistics:

I will pre-record lectures on Panopto, and will use class time as an office hour. On **Mondays** and **Wednesdays** I will give brief summaries of the lecture, take questions on lecture material, and give you practice problems to work on. The **Friday** office hour will be less directed - I'll just be logged in and take questions if there are any. In order for all this to work, I expect you to watch the lecture *before* class time.

Exams (two midterms and the final) will be remote like everything else. They will be timed, and I will have you take photos of your solutions and submit them electronically. I assume most everyone has the technology to do this (i.e. a phone) but if not, please let me know ahead of time. I will never require you to have your camera turned on; the exams will be given on the honor system.

The final exam for this class also normally serves as the Masters Review Exam (MRE). It is still to be determined how the MRE will function this quarter. I will post an update here once the Masters Review committee offers guidance. **Update:** the MRE will be a portfolio review this quarter, which means that it will be based on all of your coursework. The final exam will still happen, and it has been moved to **Monday Dec 14 10am**.

References

- Charles Kittel, *Elementary Statistical Physics*. This is the main reference for the course, although because it is somewhat dated it will be supplemented by the two references below. You

should obtain a copy of this book - it's published by Dover, so quite inexpensive. The first 6 chapters are available here.

- Daniel Arovas, *Lecture Notes on Thermodynamics and Statistical Mechanics*, available for free at https://courses.physics.ucsd.edu/2010/Spring/physics210a/LECTURES/210_COURSE.pdf

- David Tong, *Lectures on Statistical Physics*, available for free at http://www.damtp.cam.ac.uk/user/tong/statphys.html

- Landau and Lifshitz, Statistical Physics Part 1 (Vol 5) (section on adiabatic processes here)